Elizabethtown College
EGR/CS 332

Digital Design I

Fall 2021

Design of combinational and sequential digital logic circuits, and their use in computer architectures. Introduction to machine instructions and assembly language programming. Design of a simple microprogrammed computer. **Prerequisite(s):* CS 121 or permission of the instructor. Fall semester.

This course is a mandatory prerequisite for EGR/CS333 Digital Design II, Assembly Language & Interfacing (Digital & Embedded Systems Design) *and* EGR/CS433 Advanced Computer Engineering (Parallel Processing)

PROFESSOR

Joseph T Wunderlich PhD
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Coordinator of Computer Engineering and Architecture
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MEETING TIMES (for 4 contact hours = 200 minutes)

Course Credit & Contact Hours = 4&4, so we should average 200 minutes per week for 4 contact hours (50 minutes per contact hour); however we are scheduled MWF 12:30-1:50pm (= 240 minutes). Therefore we meet:

- 12:30 -1:50pm MONDAY's **only when announced in advance** *(other than first day)*
- 12:30 -1:50pm WEDNESDAY's
- 12:30 -1:50pm FRIDAY's

TEXTBOOK and OTHER SOURCES

- Arijit Saha and Nilotpal Manna, ***"Digital Principles and Logic Design,"*** (January 28, 2009), Jones & Bartlett
  NOTE: This book is simply a common reference to help you understand the material presented in lecture; it's not available in bookstore, so buy it on-line if you would like. All lectures are made from teaching this course every year at Elizabethtown College since 1999, and before that at Purdue University, and partially at the University of Delaware – with excerpts from many sources, and examples from my research at IBM and elsewhere before 1999 *(see all the details on my CV),* and research by my students and I since then.
- Some content from my YouTube Channel
- Brief look at content from my other Hi-Tech courses

GRADING

5% Homework's and in-class assignments and participation
20% Exam-1
25 % Exam-2 *(Comprehensive)*
25% Exam-3 *(Comprehensive)*
25% Semester Paper and PowerPoint

Course Grade:
(60-62)=D-, (63-67)=D, (68-69)=D+, (70-72)=C-, (73-77)=C, (78-79)=C+, (80-82)=B-, (83-87)=B, (88-89)=B+, (90-92)=A-, (93-100)=A
(with any fractional part rounded to the nearest integer)

COURSE OUTLINE *(a guideline for expectations; changes may be made during the semester)*Digital Design and Embedded Systems case studies throughout course

I. (WEEK 1) Mathematical Model, Reasoning, and Elementary Combinatorics
II. (WEEK 2) Binary logic and gates and Elementary Combinatorics
III. (WEEK 3,4) Boolean Algebra, Forms, Proofs, and Functional Minimization and Map simplification
IV. (WEEK's 5 to 8) Combinational circuit design
   A. Adders
   B. Subtractors
   C. Multipliers
   D. Various application specific designs
   E. Bit-Slice design
V. (WEEK's 9 to 12) Sequential circuit design
   A. Counters
   B. Control unit finite state machines
   C. Unused states
   D. Various application specific designs
VI. (WEEK 13 to 15) A simple microprogrammed computer design
   A. Register transfer and pipelined CPU data paths
   B. CPU sequencing and control
   C. Instruction set architectures
   D. Assembly language Intro

SEMESTER PROJECT

- Individuals only
- On project due-date, both written and oral reports are due **(submit in CANVAS).** Oral report must be done using PowerPoint created by you for this course. It should take **5 minutes max IN PPTX-WITH EMBEDDED AUDIO or a YOUTUBE VIDEO,** and contain an appropriate number of visuals.
- Paper requirements:
  - 10 point, two-column format, single-spaced, **4 to 6** pages unless you build something that functions, in which case you may submit only 2 to 3 pages
  - **IEEE formatting standards for citations, equations, and paper structure** as specified here:
    - http://users.etown.edu/w/wunderjt/IEEE_CONF_PAPER_FORMATTING.pdf
  - Include at least one paragraph in sections titled:
    - ABSTRACT (one or two paragraphs)
    - INTRODUCTION (brief summary of historically significant contributions to topic)
    - DISCUSSION (or DESIGN DECISIONS if you are creating something)
    - CONCLUSIONS
    - REFERENCES (i.e., bibliography)
      - Excessive use of Wikipedia and non-peer-reviewed citations will be penalized
    - APPENDICES for supporting materials if you have any (e.g., simulation code, sketches, data collected, manufacturers literature, industry standards, etc.)

Some possible topics are:

- Remote-learning technology improvements
- Remote-work technology improvements
- Robotics (e.g., assisting people in quarantine, space-exploration, search & rescue, hazardous waste removal)
- Medical applications such as:
  - Sensing contaminants
  - Mitigating environmental impacts
  - Biological implants
  - Medical Imaging
  - Medical Databases
  - Bioinformatics
- Hi-Tech Environmental sensing and Clean-up in Buildings, Cities, Mass-Transit, and Entertainment venues
- Virtual and/or Augmented Reality
- Supercomputer applications
- Cloud Computing
- Ubiquitous computing
- Simulations for discrete Mathematics
- Supercomputer hardware design
- Application Specific Integrated Circuits (ASIC's)
- Digital circuit simulators
- Industrial automation – e.g., PLC's (Programmable Logic Controllers)
- Embedded system design
- Neural network hardware
- Machine Learning
- Digital controllers for toys such as model railroads
- Smart-house computer hardware
- Applications for space exploration
- Green computing
- Assistive technologies for the disabled
- IBM Watson
- Enterprise Servers
- Cybersecurity
- Hi-Tech investment algorithms and AI techniques

TIPS ON PRESENTATIONS:

- **Minimize unnecessary details**
- Less than 30 words per slide
- Don't have too many slides
- Ensure good contrast between text and background (will the lights be on?)
- A picture is worth a thousand words -- an equation or graph can be worth much more
- Put an image on every page (clip-art, photo, animation) which is an abstraction of the subject
- Don't read from script
- Don't speak monotonically
- Make eye contact with audience (or if recorded, consider a small window with your face narrating in the corner (but not blocking slide content)
- Have a clear objective (to entertain, to sell, to motivate, or to report findings)
- Have a good opener (an agenda, a quotation, a question, or a declaration)
- Be organized and logical (present problem then solution; or have priorities – least-to-most or most-to-least)
- Have audience's expectations understood (provide meaning and/or motivation); assume your peers may see & hear it
- Have good transitions between main points
- Have a good closing (summarize main ideas, restate purpose of presentation)
- Be flexible (adapt if questions are allowed to be asked during presentation)
- Any embedded video clips should only be a minute long, at most

LEARNING OUTCOMES

COMPUTER ENGINEERING Targeted Tasks Rubric

J Wunderlich PhD
Program Coordinator

Yellow / Highlighted = Graded student works collected in Binders for internal & external-ABET review

2018/19 New ABET Learning Outcomes An ability to:

(ABET-1) Identify, formulate, and **solve** complex engineering problems by applying principles of engineering, science, and mathematics.

(ABET-2) Apply engineering **design** to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(ABET-3) **Communicate** effectively with a range of audiences.

(ABET-4) Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the **impact** of engineering solutions in global, economic, environmental, and societal contexts.

(ABET-5) Function effectively on a **team** whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(ABET-6) Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (**LAB's**).

(ABET-7) Acquire and apply new knowledge as needed, using appropriate **learning** strategies.

Pre-2018/19 ABET Learning Outcomes

(ABET-a): An ability to apply knowledge of mathematics, science, and engineering.
(ABET-b): An ability to design and construct experiments, as well as to analyze and interpret data.
(ABET-c): An ability to design a system, component, or process to meet desired needs.
(ABET-d): An ability to function on multi-disciplinary teams *if possible, or to draw on the talents of others*
(ABET-e): Identify, formulate, and solve engineering problems
(ABET-f): An understanding of professional and ethical responsibility
(ABET-g): Communicate effectively orally and in writing
(ABET-h): A broad education necessary to understand the impact of engineering solutions in a global and societal context
(ABET-i): Recognition of the need for, and an ability to engage in life-long learning
(ABET-j): Knowledge of contemporary issues
(ABET-k): An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

H = High Emphasis in Course
M = Medium Emphasis in Course
L = Low or no Emphasis in Course

	Solve Problems	Design	Communication	Ethics & Impacts	Teamwork	Labs	How to learn	CREDITS	CONTACT HOURS
2018/19 New ABET Learning Outcomes:	1	2	3	4	5	6	7		
Pre-2018/19 ABET Learning Outcomes:	aek	ck	g	fhj	d	bk	i		
CS 121 Computer Science I	H	H	M	L	L	H	H	4	4
CS 122 Computer Science II	H	H	M	L	L	H	H	4	4
EGR 191 Introduction to Engineering I **LECTURE & LAB**	M	M	H	M	M	H	H	4	**6**
EGR 192 Introduction to Engineering II	H	H	M	H	H	L	M	2	4
EGR 210 Circuit Analysis **LECTURE & LAB**	H	H	M	L	L	H	L	4	**6**
EGR/CS 222 Systems Programming	H	H	M	L	L	H	H	4	4
EGR/CS 230 Computer Architecture & Hi-Tech Fundamentals	L	M	M	H	L	L	H	4	4
EGR 310 Signals and Systems	H	M	M	L	L	H	L	4	4
EGR 311 Electronics **LECTURE & LAB**	H	M	L	L	M	H	M	4	**6**
EGR/CS 332 Digital Design I	H	H	M	L	L	L	M	4	4
EGR/CS 333 Digital Design II, Assembly Language, & Interfacing **LECTURE & LAB**	H	H	H	L	H	H	M	4	**6**
EGR 410 Control Systems **LECTURE & LAB**	H	M	M	M	M	H	L	4	4
EGR/CS 422 Operating Systems	H	H	M	L	L	H	H	4	4
EGR/CS 433 Advanced Computer Engineering **LECTURE & LAB**	H	H	H	L	H	H	M	4	**6**
Elective: EGR/CS434 Robotics & Machine Intel, CS342 Networking, or EGR315 Communication Theory	Variable							4	4
EGR 401 Senior Project in Engineering I	H	H	H	M	M	H	M	2	
EGR 402 Senior Project in Engineering II	H	H	H	M	M	H	M	2	

ATTENDANCE

Class participation is part of your course grade. Also, exams cover mostly material that is only presented in lecture.

SCHOOL CLOSURE / CLASS CANCELATION

Additional work assigned to cover any class cancelation

NO CELL PHONE OR LAPTOP USE IN CLASS

This can very much affect your grade. No laptop use is allowed without a documented need by Elizabethtown College student services. Research now shows that taking hand-written notes is better for learning: http://www.npr.org/2016/04/17/474525392/attention-students-put-your-laptops-away

ACADEMIC HONESTY

Elizabethtown College Pledge of Integrity: *"Elizabethtown College is a community engaged in a living and learning experience, the foundation of which is mutual trust and respect. Therefore, we will strive to behave toward one another with respect for the rights of others, and we promise to represent as our work only that which is indeed our own, refraining from all forms of lying, plagiarizing, and cheating."*

See the 2016-17 Elizabethtown College Catalog, "Standards of Academic Integrity"
(http://catalog.etown.edu/content.php?catoid=10&navoid=507#Academic_Judicial_System)
or Academic Integrity at Elizabethtown College, 11th ed.
(https://www.etown.edu/offices/dean-of-students/files/academic-integrity-handbook.pdf)

DISABILITY SERVICES, RELIGIOUS OBSERVANCES, and COVID- RELATED EXPECTATIONS

DISABILITY SERVICES

Elizabethtown College welcomes otherwise qualified students with disabilities and is committed to providing access for all students to courses, programs, services, and activities. If you have a documented disability such as a learning disability or chronic illness or a new circumstance such as a concussion and would like to request accommodations please contact Lynne Davies, Director of Disability Services by phone (717-361-1227) or e-mail (daviesl@etown.edu). The Office of Disability Services can provide resources to you and facilitate communication with faculty about reasonable accommodations. After meeting with the Office of Disability Services, please set up an appointment to meet with me, the instructor, to discuss the accommodations as they pertain to my class.

RELIGIOUS OBSERVANCES

The College is eager to facilitate individual religious beliefs and practices whenever possible while retaining course student learning outcomes. It is your responsibility to meet with the class instructor in advance to request arrangements related to your religious observances that may conflict with this class, and to make appropriate plans to make up any missed work.

COVID-RELATED EXPECTATIONS

All students are expected to adhere to the established community expectations around safety, which may include any or all of the following, as appropriate given vaccination status and indicated in the up-to-date guidance provided on the College's COVID-19 website: daily digital health reporting, physical distancing, proper wearing of face masks, frequent handwashing, and participation in cleaning and sanitizing protocols. You will be turned away from class if you do not adhere to College guidance. Students diagnosed with a health condition that they believe precludes their adherence to College guidance should contact Lynne Davies in Disability Services (daviesl@etown.edu) to discuss reasonable accommodations.

If you are exhibiting any symptoms of COVID and/or marked "yes" to any question on the daily health screen and are awaiting next steps from a physician or Student Health, do not come to class. Failure to adhere to the established community expectations around safety will result in notification of Campus Security and application of the student conduct process for failure to comply, endangering the well-being of others, and/or disorderly conduct. The student code of conduct applies also to participation in all virtual activities, including, for example, Zoom sessions and Canvas discussion boards.